

METHOD AND APPARATUS FOR REPRODUCING IMAGE FROM DATA OBTAINED  
BY DIGITAL CAMERA AND DIGITAL CAMERA USED THEREFOR

BACKGROUND OF THE INVENTION

5                   Field of the Invention

The present invention relates to a method and apparatus for reproducing images, using a printer or a monitor, from digital image data obtained by a digital camera, and also to a digital camera used for implementing the method.

10                   Description of the Related Arts

The quality of a picture, especially the finish of a color picture, generally varies greatly depending on exposure conditions. Therefore, a camera has an AE mechanism for setting an appropriate exposure in response to how bright it is when a picture is recorded and luminance distribution on a target object. However, even an AE mechanism has a limit, and performance of the mechanism varies from camera to camera. Therefore, it is not necessarily guaranteed that a picture having a sufficient quality can always be recorded.

20                   For this reason, at a photo shop or the like, processing for correcting overexposure or underexposure, and a bias in color is carried out by adjusting an exposure condition when a picture image is printed so that a picture print having as high a quality as possible is provided to a customer. In this case, image processing to be carried out obviously varies  
25                   depending on a picture to be processed. Therefore, an optimal processing condition has been found by repetitive adjustments

of an image processing condition based on a slight difference judged by experience in images shown on a monitor, or by confirming finish after a plurality of test prints have been created. Based on the image processing condition having been found, image processing is carried out to create a print which will finally be provided to a customer.

When an electronic camera using an electronic image pickup device (hereinafter called a digital camera) is used, the camera can often not carry out highly sophisticated processing due to restrictions on cost and processing time. In the case of a digital camera, an image obtained thereby may often be used as it is without a photo shop's involvement. Therefore, an AE mechanism having high performance may often not be incorporated with a digital camera, since picture quality is meant to be sufficient as long as an image displayed on a monitor having a comparatively generous tolerance in picture quality, such as an image displayed on a CRT monitor or on a liquid crystal display monitor attached to the digital camera, is not too blurry. As a result, when digital image data recorded by a digital camera are reproduced as a print, it is not easy to obtain optimal finish of a printed image having a strict picture quality tolerance, and a time consuming operation such as repeated test prints as described above is necessary.

However, correction by trial and error as described above is not only time consuming but also costly due to the test prints. It is also problematic that finish varies depending on

experience or the skill of an operator who carries out the adjustment.

#### SUMMARY OF THE INVENTION

Based on consideration of the above problems, an object of the present invention is to provide an image reproducing method and apparatus which finds an optimal image processing condition quickly and simply without repetitive adjustments of the condition by test prints or confirmation of an image using a monitor, so that a high quality print can be promptly provided to a customer, when digital image data obtained by a digital camera are reproduced. Another object of the present invention is to provide a digital camera used for implementing the method.

An image reproducing method of the present invention comprises the steps of obtaining digital image data to which recording information representing a recording condition is added by a digital camera having a function of adding the recording information to the digital image data recorded thereby, storing in a predetermined storage medium the digital image data to which the recording information has been added, carrying out image processing for enhancing picture quality of the digital image data stored in the storing medium by using the recording information added to the digital image data, and reproducing the digital image data on which the image processing has been carried out.

The "recording information representing a recording condition" herein means, for example, to include both

information specific to a camera such as the  $\gamma$  property of the camera (a ratio of input light amount versus output voltage) and the focal length of the lens, and information which varies at each recording depending on a photo taking environment or on an operation by a photographer, such as a focusing length, an EV value, a kind of lighting (color temperature), and whether or not a flash is used. The former information (the information specific to a camera) is unconditionally added as a portion of the recording information, and a photographer can not change this information. On the other hand, a photographer can intentionally determine the latter information by carrying out some operation.

"Adding recording information representing a recording condition to digital image data recorded" means that a file format comprising image data and recording information is determined, and the image data as well as recording information thereof are stored as a file having such a format in a built-in memory of a camera or a card memory, for example.

The "predetermined storage medium" herein means a built-in memory or the like attached to a camera, or a hard disc connected to an image server in a photo laboratory system or to a personal computer. In this case, image file copy from a memory attached to a camera to such a large capacity storage medium can be carried out using a card reader and a cable connection or the like.

The "image processing for enhancing a picture quality of the digital image data" means to carry out processing

according to a predetermined algorithm based on a given condition. For example, the processing means to select a look-up table for correcting tone or a color. In this case, "carrying out image processing for enhancing a picture quality of the digital image data by using the recording information added to the digital image data" means to use the recording information in the processing for selecting an optimal look-up table.

Furthermore, according to the image reproducing method of the present invention, a variety of processing conditions of the image processing may be added to the digital image data after the image processing has been carried out thereon, and stored in the storage medium. The image processing for enhancing the picture quality of the digital image data may then be carried out using the processing conditions added to the digital image data which has been stored in the storage medium so that the digital image data which has been image processed can be reproduced.

"A variety of processing conditions of the image processing may be added to the digital image data" herein means, in the case of tone or color correction described above for example, to add the look-up table (LUT) found through the processing to the digital image data. In this manner, when the "image processing for enhancing a picture quality of digital image data" is carried out, the processing load can be reduced, since the digital image data may only be converted using the

look-up table without carrying out the processing for finding out the processing conditions.

The image reproducing apparatus of the present invention is used for implementing the above image reproducing method, comprising image processing means for carrying out the image processing for enhancing a picture quality of the digital image data using the recording information added to the digital image data, and reproducing means for reproducing the digital image data which have been processed by the image processing means.

"The image processing means" may be means which carries out the image processing for enhancing a picture quality of the digital image data by using, instead of the recording information, the conditions of the image processing added to the digital image data.

A digital camera used for obtaining digital image data to be reproduced by the image reproducing method of the present invention comprises recording information adding means for adding the recording information to digital image data obtained by recording by the digital camera.

The image reproducing method and apparatus of the present invention has been created so that the method and apparatus adds, upon picture image recording, the recording information representing a recording condition to the digital image data obtained by a digital camera, and carries out the image processing for enhancing a picture quality using the recording information upon reproduction of the digital image data. Therefore, image processing for reproduction based on a

recording condition can be carried out, and print having optimal finish can easily be obtained without repetitive test prints.

Moreover, not only the digital camera but also the image reproducing apparatus can add an optimal image processing condition obtained through a processing or the like to the image data. Therefore, for image data whose image processing condition has been found once, image processing thereafter is carried out by simply referring to the image processing condition, and the time for finding the image processing condition will no longer be necessary.

#### BRIEF DESCRIPTION OF THE DRAWING

Figure 1 shows an embodiment of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, a preferred embodiment of the present invention will be explained referring to the accompanying drawing. Figure 1 shows an embodiment of the present invention, and depicts a schematic laboratory system for reproducing image data obtained by a digital camera in the form of a print or the like.

A digital camera 1 comprises, as does a conventional digital camera, an image pickup unit 4 such as an optical system for carrying out recording, and an AE processing unit 5 for carrying out automatic exposure processing. A function such as automatic focusing is meant to be included in the image pickup unit 4. However, the presence or absence of such a function or a level thereof varies depending on the type of digital camera.

The digital camera 1 of the present invention further comprises a recording information adding unit 6. The recording information adding unit 6 is used to add a variety of recording information to digital image data obtained by recording. The information to be added is as listed below, for example.

First, the  $\gamma$  property representing a ratio of output voltage to an input light amount is listed as information specific to a camera. The  $\gamma$  property affects contrast of a picture, and often varies between cameras with a high price and a low price. As information specific to a camera other than the  $\gamma$  property, a focal length and F value of a lens can be listed.

It is also preferable to add the content of AE processing carried out by a camera as the recording information. As AE processing which is generally carried out, average processing, peak value processing, multipattern processing and the like are known. In this case, information regarding which of these processings have been carried out, or a parameter used in the processings should be added as the recording information. Likewise, it is also preferable to add an EV value showing how bright a target object is as the recording information.

However, if an exposure has been carried out by a manual operation rather than an automatic operation, it is preferable to add a variety of values set manually as the recording information. In this manner, the intentions of a photographer can be reflected in recording information, such as whether the



atmosphere of a picture is merry or gloomy, and whether the picture has a sharp impression or a soft impression. As a result, image processing which reflects a photographer's intention can be carried out.

5           Some digital cameras enable designation of a photographer's intention by using a more vague expression rather than by setting a value such as an exposure value. For example, in some digital cameras, a mode setting can be possible such as a sun set mode when the sun is in the background of  
10 a picture being recorded, and a portrait mode when a figure is being recorded, and automatic exposure setting can be carried out based on the set mode. In the case where such a digital camera is used, it is better to provide such mode setting information to the digital camera as the recording information.  
15 In this manner, for a picture that a photographer wishes to finish as a sun set picture, sun set finish is carried out in the image processing and a print of a sun set can be provided in accordance with the photographer's imagination can be provided. Likewise, a picture can be reproduced in accordance  
20 with the intention of a photographer by carrying out optimal image processing based on each recording information such as snow finish for a picture expressing a sense of snow, scenery finish for a picture emphasizing scenery, portrait finish for a picture emphasizing good complexion (skin color), and  
25 monochrome finish for a picture to be produced in black and white.

Contrarily, since some users wish no correction processing at a photo shop, a designation for no correction to show that no correction is necessary can sometimes be provided as a camera function. In this case, the designation for no correction should only be included in the recording information.

Furthermore, some cameras with a highly sophisticated function may include a trimming designation function. In this case, only rough information specified by the camera function (for example, a designation such that only one person in the picture should be trimmed, or two persons should be trimmed) may be included in the recording information, and a detail designation of the area to be trimmed may be left to a photo shop's discretion.

Moreover, since a focusing length, a focusing position, and the like become important information when the image processing is carried out, it is better if they are included in the recording information. For example, when image processing is carried out upon printing, processing for extracting a main target object may be carried out for especially improving a picture quality of the main target object. If information relevant to focus is added as the recording information, it is judged that the main target object exists in an area of focus, and a complex extracting processing does not need to be carried out.

For reflecting on an image processing a kind and strength of light in the environment in which a picture image is recorded,

it is preferable that a lighting condition obtained by a color temperature sensor or an exposure meter, whether or not a flash is used, and weather at the time of recording if the recording is carried out outdoors, are included in the recording information.

It is also possible to add to image data the date and time of recording, or a theme title of the picture as a portion of the recording information.

The recording information adding unit 6 obtains the above recording information relevant to values specific to the camera from a setting of a camera upon shipment. On the other hand, the recording information adding unit 6 obtains recording information varying at each recording from the image pickup unit 4 or the AE processing unit 5 upon necessity by receiving data therefrom. The recording information adding unit 6 organizes the recording information into a predetermined format and adds the recording information to image data. More specifically, when image data are obtained and stored in a built-in memory or in a card memory, image data 8 together with the recording information 9 are stored in a set in an image file 7.

The digital image data having been stored in a memory in a digital camera are stored in an image server 2 via a card reader and a cable. Any ordinarily-used data copying method including the method using a network can be used as a method to copy the image file onto the image server 2.

On the other hand, the image reproducing apparatus 3 of the present invention is used to carry out sequential reproduction processings on image files 7 stored in the image server 2. The image reproducing apparatus 3 comprises a set-up  
5 processing unit 11 for carrying out image processing to enhance a picture quality of image data in each image file 7, a printer 12 or a display interface 13 for respectively outputting the image data having been set up by the set-up processing unit 11 in the form of a print 14 or in the form of a display on  
10 a monitor 15. The above recording information 9 is used directly for the processing in the set-up unit 11 or for judgment as to whether or not a predetermined processing should be carried out.

The set-up processing unit 11 carries out the processing  
15 according to a predetermined algorithm based on the recording information 9, and carries out the image processing by finding an optimal image processing condition. An image processing condition 10 may be added to image data 8 on this occasion. In this manner, it becomes unnecessary to carry out the same  
20 processing again when a print is created as an extra print for example, which leads to less time and cost. Furthermore, a print needs a higher picture quality than a display on a monitor. Therefore, once an image processing condition has been found and saved for the print, a high picture quality image can  
25 thereafter be displayed in a short time by using the saved information, when the image data are displayed on a monitor.

In the above explanation, a laboratory system has been used as an example, since a high quality picture image is especially needed by a print. However, the present invention can also be applicable to a case where a user enjoys an image using a personal computer. In other words, it becomes possible to display a high quality picture image on a monitor by carrying out the image processing using the recording information 9 with a personal computer in the same manner as does the above laboratory system.